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ABSTRACT

Multidimensional scaling was applied to the assessment of qualitative data relating to an optometry faculty's perceptions of instructional media. Results indicate that 35mm slides, overhead transparencies, and filmstrips were viewed as serving a similar function and as acceptable in terms of cost, need, and convenience. Television and 16mm films were perceived as cost unacceptable, unnecessary, and inconvenient. This study exemplifies the use of the multidimensional scaling technique for analyzing qualitative data of value for decision making. (STS)

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AN APPLICATION OF MULTIDIMENSIONAL SCALING IN THE COLLECTION OF QUALITATIVE INFORMATION FOR DECISION MAKING

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AN APPLICATION OF MULTIDIMENSIONAL SCALING IN THE COLLECTION OF QUALITATIVE INFORMATION FOR DECISION MAKING

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ABSTRACT

Though inquiry may serve many purposes within instructional development, one of the more prevalent may be to aid in increasing our precision in planning, implementation and evaluation. This increased precision may be approached by utilizing new methodologies that can provide the developer with a more formalized picture of the people and the environment in which instructional development functions.

Systematic educational decision making required that we select a course of action from a series of well defined alternatives. The basis for this selection is data which should be of sufficient breadth to reflect the diversity existing within our decision making environment. These data should be of both a qualitative and quantitative nature. In the past, quantitative data such as cost, funds available, time, number of personnel, etc., have been utilized extensively at the expense of the qualitative data. Qualitative data, when used, have been treated intuitively or at least with less rigor. In organizations where their members are expected to implement as well as co-exist with the choices of decision makers. qualitative data concerning perceptions are vital.

A faculty development team within the School of Optometry, Indiana University, became interested in the possibilities of utilizing television in their instruction. In addition to traditional quantitative analyses, multidimensional scaling was employed to determine the qualitative perceptions of the teaching faculty among eight types of instructional media and television. The results indicated that these media were perceived along the dimensions of need, cost and convenience. Utilizing this information, steps were suggested that may insure a more successful implementation of televised instruction.

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David P. Rutt

Introduction

How does a faculty perceive television, 35mm slides, and other types of media utilized in the classroom? If we were trying to introduce the faculty to classroom television and encourage its use, how could we effectively do so? These questions and others concerned a faculty development team working within the School of Optometry, Indiana University.

During the past academic year the author assisted this team in the development of a new course. During our many discussions, the team expressed an interest in the utilization of media, particularly television. The suggestions for the utilization of television called for equipment ranging from the highly portable to a more permanent studio facility. Since any decisions made concerning television or the purchase of other types of media would involve the entire faculty, they decided that information would be needed to determine how the faculty perceived television in relationship to other media. This paper will demonstrate how multidimensional scaling was applied to the assessment of faculty perceptions and how this information might be used by decision makers. However, first we will examine the types of data currently available to decision makers and the need to increase this data base.

Data and Decision Making

Systematic educational decision making requires that we select a course of action from a series of well defined alternatives. These decisions may range from the purchase of new laboratory equipment to

the implementation of an entire curriculum. What ever the case, dysfunctional decisions can have serious effects in terms of organizational disruption, and the inefficient expenditure of scarce funds in addition to not having accomplished the desired goals (Chase, 1969).

The basis for decision making is data which are utilized in choice behavior (Tanner, 1971). The data collected should be sufficiently broad based to reflect the diversity existing within the decision making environment. The greater the congruity attained between our information and reality the more we may reduce uncertainty, and increase the accuracy of our decisions (Drucker, 1967).

Quantitative data such as costs, funds available, time, number of personnel, equipment, etc., are relatively easy to collect. Consequently, many choices resulting from the decision making process have been based solely upon this type of data. However, decision makers do not function in a vacuum. The decisions that are made will inevitably have some effect upon the people in their organization. This "people effect" becomes particularly important in organizations such as colleges, universities and hospitals where the organizational members themselves must implement as well as co-exist with the decision maker's choices. Qualitative data reflecting the diversity of perceptions held by these individuals have been difficult to quantify and thus have been utilized only on an intuitive level in the decision making process. However, qualitative data collected in a more rigorous fashion would enable us to expand our data base and, hopefully, increase the utility of our decisions. Qualitative data that would provide us with an assessment of those perceptions might suggest support for the initial decision, new directions to consider or steps needed to modify existing perceptions before implementation of decisions.

Within the past ten years multidimensional scaling (MDS) has appeared as a methodology that may enable decision makers to quantify perceptions and employ them formally in decision making. In the following section we will discuss multidimensional scaling in detail.

Multidimensional Scaling

Multidimensional scaling (MDS) is a method for locating stimulus points representing, for example, cars, textbooks or frozen foods in a Euclidean space such that the distances between those points represent the perceived similarities expressed by all subjects among those stimuli (Green and Carmone, 1970). The result could be viewed as an n dimensional map (for example) with the stimuli located at varying distances from one another depending upon the degree of perceived similarity. The stimulus points located closer together can be interpreted as being perceived more similar than those that are located farther apart. It also becomes possible to suggest dimensions along which people make their judgements concerning those stimulus points.

Multidimensional scaling has found wide use in the field of product marketing where a concern is with the perceptions and preferences of the consumer. It has also demonstrated utility in the evaluation of statistical concepts (Traub and Hambleton, 1974), and the determination of faculty and student perceptions regarding the "ideal" professor (Subkoviak, 1974). MDS has also been utilized in such diverse fields as social studies, engineering, linguistics, and anthropology (see Romney, Shepard and Nerlove, Vol. I, 1972 and Subkoviak, 1975).

With the above discussion in mind, we may now suggest how MDS could be useful to our faculty planning group. MDS might enable us to determine the relationship between television and other types of media

employed by the teaching faculty in terms of perceived similarity and dissimilarity. However, since no criteria for comparison are usually made explicit with MDS, it will be necessary to identify the dimensions along which such a comparison occurred. If the dimensions of comparison are identified we may then be able to make possible prescriptions that could prove useful to decision makers.

Procedure

An instrument was designed and distributed to the teaching faculty within the School of Optometry. The instrument used a paired comparison format that presented all possible pairs of the nine media under study (36 pairs) and asked each respondent to judge the degree of similarity-dissimilarity on a scale ranging from one to nine respectively. The media used included television, 35mm slides, overhead transparencies, textbooks, 16mm films, filmstrip cassettes, audio cassettes, filmstrips and drawings. In addition, we requested that these media be assigned a value from one to nine for each of the following properties: cost (unacceptable-acceptable), need (unnecessary-necessary), instructor creativity (small opportunity-large opportunity), convenience (easy-difficult), student learning (unimportant-important), teaching (ineffective-effective). It was expected that these properties might act as explanatory dimensions and were selected on the basis of the author's experience. They do not preclude the possibility that other properties could have been useful.

Analysis

The analysis of the resulting data (N = 9) was done with the use of two MDS programs: KYST and PROFIT.

KYST (Kruskal, Young and Seery, 1973) is a general program that utilizes the similarity-dissimilarity data from the paired comparisons. It will locate each stimulus (the media) in a space reflecting the degree of similarity between stimuli as mentioned above (Figure 1.). The more dimensions we have, the easier it is to obtain a good "fit" (congruence) between the calculated similarities and the actual similarities expressed by respondents. To ease our interpretation, we would like to have the best fit in the fewest number of dimensions. The number of dimensions we select is determined by a value produced within the program called "stress." This is a measure of the fit between our calculated similarities and the actual input similarities. Stress can vary from 0.00 (perfect fit) to 1.00 (no fit) with an optimal value of 0.05 (Kruskal, 1964).

PROFIT (Chang and Carroll, 1970) then uses the coordinates of the stimulus points (media types) from the KYST created space, together with a measure of each property on the nine media to position a vector for each property in that space such that the distances projected from each stimuli to a given vector are as small as possible (Figure 2.). A multiple correlation coefficient is calculated to indicate how well each property vector fits into the space.

Results

The KYST program gave two possible spaces from which to select. Since there was very little difference between the stress value for the two dimensional (0.0234) as compared with a three dimensional solution (0.0403), the two dimensional space was selected for ease of interpretation.

The resulting two dimensional space may be viewed as a space much like this piece of paper. The points are located in relation to one

another and not to an orthogonal set of axes. Thus, the problem of interpretation comes with explaining the relationship between the stimulus points. This can be done in three ways: (1) we may examine the relationship between the points visually, (2) we may interpret the points by utilizing the axes that the KYST program locates in the space or (3) we may locate our own axes via a program such as PROFIT within the KYST space. Our discussion will cover all three levels.

With the inspection of Figure 1., we can begin to suggest how the Optometry faculty perceive media. Based upon the close spatial proximity of 35mm slides, overhead transparencies and filmstrips, we can suggest that the faculty appear to view these media as being similar. In addition, television is perceived as being more similar to 16mm films than any other type of media. Textbooks are viewed as being dissimilar based upon their "distance" from the other instructional media. We would expect this since it is the only print medium on the list. Filmstrip/cassettes are located close to 16mm films and television, possibly due to the visual and audio aspects of all three. Kemp (1971) suggested similar relationships based upon audio and visual characteristics used in a media selection flowchart for large group instruction. Based on this, we may conclude that the Optometry faculty have demonstrated relationships between instructional media that are acceptable in terms of the existing literature.

Figure 2. shows the two dimensional configuration containing the axes located in the space by KYST. To interpret the relationship between the points, Green and Carmone (1970) have suggested a number of ways that these axes can be identified; the most common is an examination of the relationship of each stimulus along each axis. Using this method we can

see that all the media that receive heavy use by the faculty are found to the left of the vertical axis and those not used to the right. This suggests that we might label Axis I "experience-inexperience." The vertical axis is much more difficult to interpret but appears to be a "verbal-visual" dimension with textbooks and audio cassettes at the top and more visual media toward the opposite end. Discussions held with various faculty further supported the interpretation of these axes.

The PROFIT program calculates for each property a multiple correlation coefficient which will be found in Table 1. This value provides us with an idea as to how well these properties fit into the MDS space. Using the criterion of selection recommended by Wilson (1974), all properties with an R below .70 were not used in the final interpretation but were still included in Figure 2.

Insert Table 1. about here.

It is interesting to note that the properties of teaching, instructor creativity and student learning do not seem to fit into the space. This could be due to varying interpretations of these terms since their definition was left up to the respondent.

Each axis has been labeled at the high end of its respective scale. By projecting each medium directly onto the axis, we can begin to interpret the perceptions of the faculty along each of these properties. It should be kept in mind that we used ordinal data so we will be unable to say how much one medium is preferred over another.

Textbooks, 35mm slides, drawings and overhead transparencies (the media in use) are perceived as being acceptable on cost, need and convenience. Television and 16mm films are perceived as cost-unacceptable,

unnecessary and inconvenient (difficult) with filmstrips, filmstrip/cassettes and audio cassettes appearing to be of a moderate value along these axes.

Discussion and Conclusion

From Figure 1., it appears that the faculty perceive acceptable relationships between the media employed in the classroom. Those media with which they have had experience are perceived favorably in that they are viewed as being necessary, cost-acceptable and convenient. The "convenient" dimension may possibly reflect the success of the existing media support services which provide equipment and materials when they are needed, with a minimum of inconvenience. However, further exploration is needed to confirm this. The media with which there has been little experience, i.e., television and 16mm films, have been perceived as unnecessary, cost-unacceptable and inconvenient.

These results paint an interesting picture that speaks to the problem of introducing any new technology (television) into an organization. If one looks at the configuration in Figure 2., it will be apparent that the media that fall to the left of the "experience" axis are those one might classify as being "conventional," i.e., media one would most likely see to one extent or another in many classrooms. Those media to the right are the types one might classify as "innovative" in the sense that they are not as widely used. Addressing ourselves to television, one may ask: "Are the collective perceptions of television in terms of cost, convenience, and need responsible for the lack of experience or conversely has a lack of experience led to this perception?"

If we accept the validity of the interpretation suggested by the MDS analysis, one avenue for approaching this "experience" problem is

along the "deficient" dimensions of cost, convenience and need. Using this information a program employing a number of strategies could be initiated by the faculty development team that would include: providing the faculty with information related to the costs of television, establishing support and distribution policies, demonstrating the utilization of television in other similar organizations and providing "hands on" experience. It would also be possible to administer the same instrument across time to assess the perceptual changes that may be taking place as a result of such a program.

MDS has enabled us to assess the perceptions the faculty have held in regards to television and other media, identify possible dimensions used in these perceptions and make possible prescriptive statements that may prove useful to decision makers. The qualitative data collected through the use of MDS, however, comprise only one facet within a larger strategy of data collection for decision making. Multidimensional scaling does demonstrate that qualitative data need no longer be neglected and may be treated in a more formal fashion by decision makers.

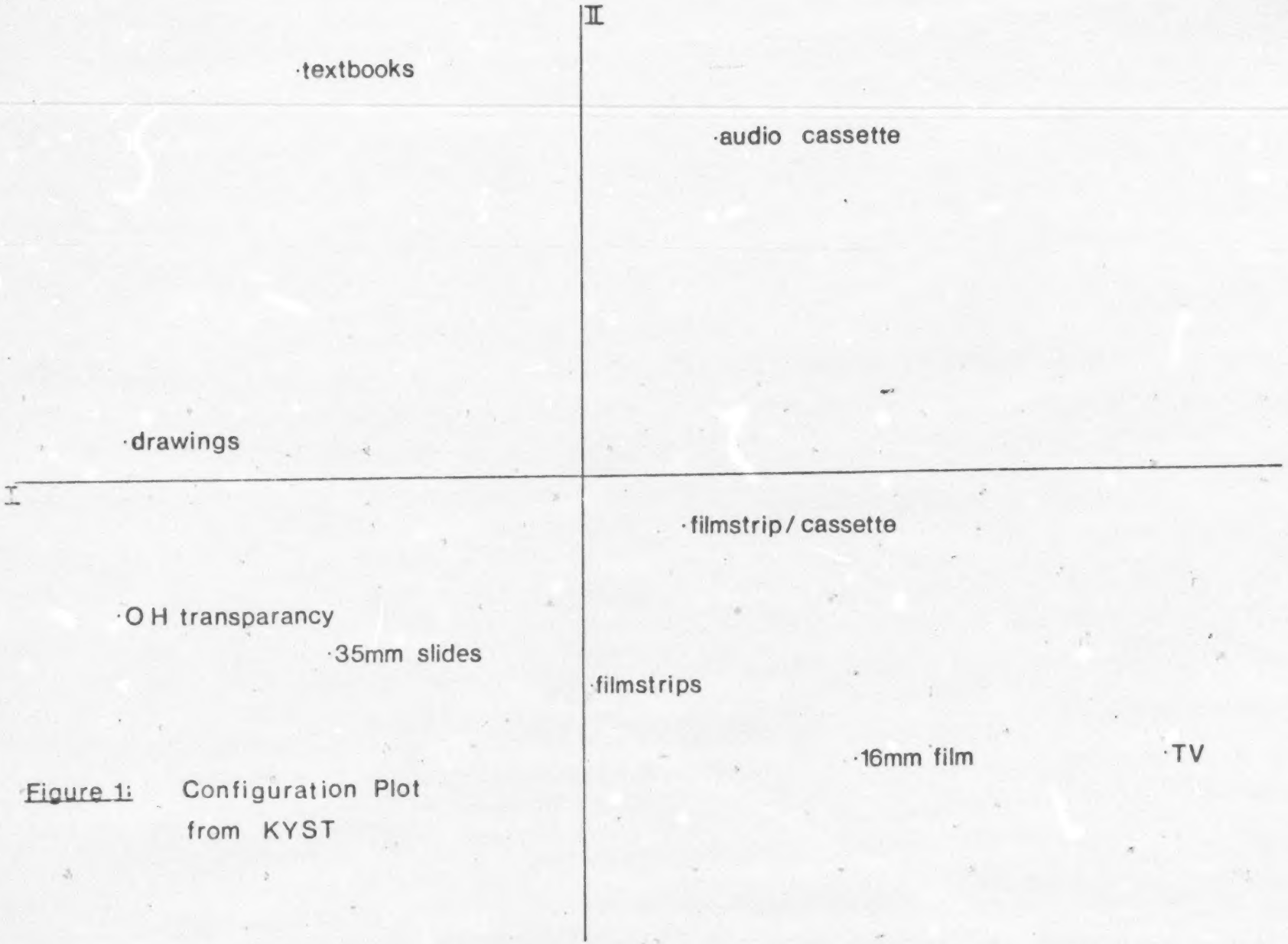
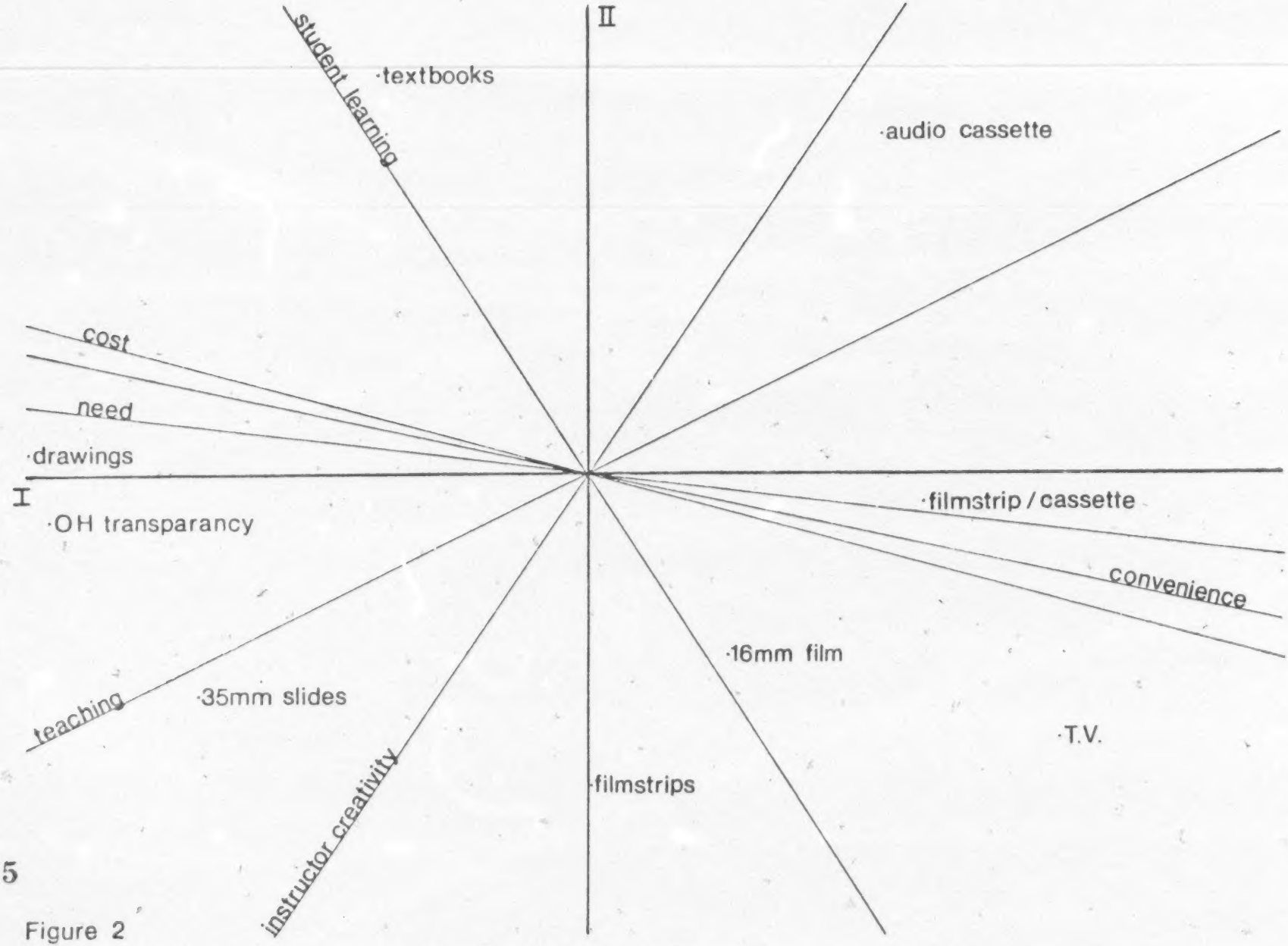


Figure 1: Configuration Plot from KYST



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16

Figure 2
Original Configuration with Property Vectors from PROFIT

PROPERTY	CORRELATION
Cost	0.9429
Need	0.8469
Instructor Creativity	0.6460
Convenience	0.9049
Student Learning	0.6376
Teaching	0.3150

Table 1: Correlation between Properties and Instructional Media in KYST space.

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